common design concepts for the learning car mechanic

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(chemicals)

The chemical issue!

When you go the parts store you'll notice how many kinds of chemicals are available. This zine is for people who are wondering what they do and which can be substituted for each other. So I'll talk a little about chemical compatibility and then go into some detail about common chemicals.

There was nothing to draw in this issue so there aren't any pictures.

Three common types of chemical

Most people are familiar with the concept of chemical incompatibility; one of the most well-known examples is that you shouldn't use oil-based lube with a latex condom, because the oil will dissolve the latex. Just like lube, car chemicals fall into one of three general categories: oil-based, silicone-based, and glycol-based.

Motor oil, gear oil, transmission fluid, power steering fluid, and bearing and chassis grease are oil-based. They're all mostly petroleum, with some additives. (Synthetic oil is made in a factory, not extracted from crude oil, so it's not techincally petroleum, but it has the same properties.)

Coolant and brake fluid are glycol-based. They both mix with water. For coolant, that's part of its job, but for brake fluid it's a liability. That's why brake fluid is supposed to be changed at regular intervals (usually two or three years); it absorbs water from the atmosphere as it sits in the brake fluid reservoir, and if it becomes too watered down, it corrodes metal brake parts.

(If you're looking at some fluid coming out of a drum brake hub area, and you want to know if it's bearing grease, gear oil, or brake fluid, you can try this: brake fluid will wipe off with water, but bearing grease and gear oil won't.)

Corrosion inhibitors don't last forever, though, so coolant needs to be changed sometimes. The manufacturer will tell you which kind to use in the service manual and maybe the owner's manual too, but you don't necessarily have to use that kind--once you know it, you can try to find different compatible brandsa compatible kind. With some research, you can find a coolant at the store that's compatible.

Dark, sludgy, opaque coolant has been contaminated with oil, usually because of a blown head gasket or broken oil cooler.

ATF (automatic transmission fluid) should be red or pink, apparently. I can't see red so I can't describe its color, but it should be clear, not dark. ATF that's black has been overheated, maybe because the vehicle was towing something too heavy for it. If you see tiny black particulate matter in the ATF, it's clutch friction material, which should normally be picked up by a magnet or filter in the transmission--if you see it, it's a sign that the transmission clutches are malfunctioning or undergoing heavy wear for some reason.

Manual transmissions almost always use gear oil instead of transmission fluid, and even some automatic transmissions (like on Subarus) use ATF for the transmission case but gear oil in the differential gearbox attached to it. Rear differentials always take gear oil.

BRAKE FLUID should be clear, the clearer the better. It gets darker as it absorbs water.

Last, a note on hoses and chemical compatibility: I've often found myself needing to replace a piece of hose from a car, and finding out that the parts store has the right size hose but it's rated for some other application. Generally, hoses rated for coolant, gasoline, diesel, refrigerant, and transmission/power steering fluid aren't interchangeable and will decay if they're used for the wrong fluid. If you're broke down somewhere and have to use the wrong kind of hose, you should probably replace it with the right one as soon as possible.

enough, and sleeve compound is used to glue it in. It's supposed to be removable only with heat. Consider this if a ball joint looks clean but won't press out.

There are a few different SOLVENTS out there: brake cleaner is a VERY toxic, flammable, and generally dangerous solution in a spray can that will blast any oil, brake dust, and/or carbon off metal parts. It's important to clean your brake parts, both because they need to be free of oil and because brake dust is harmful to breathe, but I use water or alcohol instead, because I don't want the brain damage from using brake cleaner. Electrical parts cleaner is similar but designed not to dissolve plastic wiring insulation.

About car fluids

Here are some notes about which kind of each fluid to get, and what to look for when you check fluids.

MOTOR OIL is rated for viscosity, and a higher number means thicker oil. The first number is marked with a W for "winter" and tells you approximately how much thicker the oil gets when it's cold. Sometimes people with old, leaky engines use a thicker oil than the manufacturer calls for to make it leak slower. The synthetic vs. conventional oil question is controversial and I have no opinion about it.

Oil in your engine should be transparent or translucent and free of metal shavings and chips. As oil gets used, it gets darker and darker. Light-colored, whitish, opaque oil (looks like chocolate milk or coffee with cream) has been contaminated with water or coolant, probably because of a blown head gasket. Oil that's the right color but frothy or bubbly is usually because the crankcase is too full of oil and the crankshaft is splashing in it. Brown, hard varnish on the dipstick is what happens when the oil isn't changed often enough and starts to break down.

COOLANT is mixed with water, so it always contains corrosion inhibitors to keep the water from rusting metal engine parts.

Silicone is used for seals and lubricants. Seals that come in contact with oil, like crankshaft and camshaft seals, valve cover gaskets, and the boots on CV joints and U joints, are usually made of silicone because it doesn't interact with the oil.

Oil-based and silicone-based greases are not interchangeable. Seals in brake parts, like the o-rings in the calipers and the boots on slider pins and caliper pistons, are made of natural rubber, and greasing them with petroleum bearing grease will degrade them.

Seven specific chemicals

ANTI-SEIZE is used to prevent things from sticking together. Steel bolts that go into aluminum cylinder heads or intake manifolds often seize because of galvanic corrosion. It's also a problem for a lot of suspension parts that get exposed to water when you drive; suspension bushings involve bolts going through thin metal sleeves and can easily get so seized they have to be cut out with a grinder. Wheels get stuck to rotors and rotors get stuck to hubs. Exhaust bolts get wet and also experience repeated temperature extremes, so they seize worse than anything. Some of these problems can be prevented by brushing some anti-seize onto the threads when you put them together.

Anti-seize is made of a dry lubricant like finely powdered metal, mixed with a carrier, usually silicone. Caution: it talks out of both sides of its mouth--it acts like a lubricant on threads, so anti-seized bolts shouldn't be torqued to spec, because it'll be too much and could strip the threads of the hole (see issue 2 of this zine for more about that). At the same time, it doesn't work well as a lubricant for moving parts, so it shouldn't be used on brake sliders or anything that has to move.

I don’t vouch for the effectiveness of other greases as anti-seize.

BRAKE GREASE is silicone grease designed for high-temperature applications. It's the only lubricant I use on brake parts, because petroleum grease will damage their seals, anti-seize can make them jam, and dielectric grease can get runny because of the heat.

DIELECTRIC GREASE is a silicone grease designed to keep electrical connections clean. Despite its name, it's no more or less electrically conductive than any other grease. It just keeps water and dirt out. It's especially helpful for spark plugs, where the wires or coil boots go on, because it's easy for oil and water to get in there and cause problems.

You shouldn’t use petroleum grease instead of dielectric grease because it can damage plastic wiring clips and insulation, but I don't see why it would be bad to use silicone brake grease instead. Occasionally you'll see wire connectors with a little brightly-colored silicone water seal inside them. If the seal is intact, there’s no need for dielectric grease, and in fact the silicone grease can degrade the silicone seals.

BEARING/CHASSIS GREASE is a petroleum grease with additives to make it thick. It comes in a tube you can load into a grease gun. The grease gun has a nozzle or hose with a special fitting on the end. This end presses onto grease fittings (AKA zerk fittings), which look like little nipples, and then you squeeze the handle to pump grease into the fitting. Ball joints and U joints often have grease fittings so that they can be regreased occasionally. This kind of grease is also used to pack the tapered wheel bearings you encounter on heavier trucks and the non-drive wheels of older cars. Check what you're buying, because some grease is only for bearings or only for chassis grease points. Most is multipurpose and will have a logo on the packaging that says "NLGI GC-LB". The GC means suitable for bearings and the LB means suitable for chassis. Also, it's a good idea to find out what grease the manufacturer tells you to use, and look it up to make sure it's okay to substitute a multipurpose grease from the part store.

If you don't have a grease gun, make sure that any ball joints

and tie rod ends you buy are pregreased or "sealed" (instead of "greasable"). But if you're working on bigger trucks, that might not be an option.

RTV (room temperature vulcanizing silicone) is a sealant that's used instead of gaskets in some applications, or for places where two gaskets meet (say a valve cover gasket and timing cover gasket). You apply it in a bead on one sealing surface and then put the two surfaces together and follow the manufacturer's instructions for drying time and when to torque the bolts. It cures to a slightly flexible solid, like window caulk. Some mechanics use RTV in addition to a gasket if the sealing surfaces are a little scratched and they're not sure the gasket alone will be enough, or just when it took hours to get to a gasket and they really don't want to take it all apart again if it leaks. But I use gasket compound for that instead.

GASKET COMPOUND is a sticky glue-like substance that you brush onto things. The kind I use doesn't cure like RTV, it stays sticky. It helps hold gaskets onto their sealing surfaces while you assemble them, and keeps them from falling out on the floor. I use it wherever I want extra reassurance that a gasket won't leak, but I don't use it on head gaskets, exhaust manifold gaskets, or anywhere else where RTV shouldn't be used.

THREADLOCKER is a kind of glue that's used on bolts when you need to be sure they won't work loose, especially in areas with a lot of vibration, like brakes. It cures when it's exposed to metal in the absence of air, so it stays liquid until the bolt is tightened. Once you break loose a bolt with threadlocker on it, the threadlocker doesn't do anything any more, so if you want it to be locked you'll have to add more. You'll know a threadlocked bolt by the colored dot it leaves on the threads. The blue threadlocker is designed to let go and allow the bolt to come out with enough torque, and the red kind is supposed to come out only if it's heated.

There's a similar adhesive called sleeve compound, which is used for press-in ball joints and U joint yokes. Sometimes the hole gets a little worn and can't hold a new ball joint tightly